

May 14, 1996



**Military Operations  
Research Society**

**Society of Cost Estimating  
and Analysis**

**Mini-Symposium:**

**Emphasizing Cost in Cost and Operational  
Effectiveness Analyses**

**Fairfax Virginia  
March 2 - 4, 1993**

**Donald E. Mixon, Chair**

**REPORT**

**Daniel A. Nussbaum, Editor**

19971016 160

Military Operations Research Society ♦ 101 South Whiting Street ♦ Suite 202 ♦ Alexandria VA 22304-3418

VOX (703)-751-7290 ♦ FAX (703)-751-8171 ♦ Email morsoffice@aol.com

Society of Cost Estimating and Analysis ♦ 101 South Whiting Street ♦ Suite 201 ♦ Alexandria VA 22304-3418

VOX (703)-751-8069 ♦ FAX (703)-461-7328 ♦ Email sce@erols.com

## **DISCLAIMER**

This Military Operations Research Society — Society of Cost Estimating and Analysis mini-symposium report faithfully summarizes the findings of a three-day meeting of experts, users, and parties interested in the subject area. While it is not generally intended to be a comprehensive treatise on the subject, it does reflect the major concerns, insights, thoughts, and directions of the authors and discussants at the time of the mini-symposium.

## **CAVEATS**

The Military Operations Research Society does not make or advocate official policy.

Matters discussed or statements made during the mini-symposium were the sole responsibility of the participants involved.

The Societies retain all rights regarding final decisions on the content of this mini-symposium report.

REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503				
1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE  14 May 1996	3. REPORT TYPE AND DATES COVERED  Emphasizing Cost in Cost and Operational Effectiveness Analyses Mini-Symposium, 2-4 March 1993		
4. TITLE AND SUBTITLE  Emphasizing Cost in Cost and Operational Effectiveness Analyses		5. FUNDING NUMBERS  O & MN		
6. AUTHOR(S)  Donald E. Mixon, Mini-Symposium Chair and Daniel A. Nussbaum, Editor				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)  Military Operations Research Society, Inc. 101 S. Whiting Street, Suite 202 Alexandria, VA 22304-3483		8. PERFORMING ORGANIZATION REPORT NUMBER		
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)  Office Chief of Naval Operations, N81 Washington, DC 20350-2000		10. SPONSORING/MONITORING AGENCY REPORT NUMBER		
11. SUPPLEMENTARY NOTES				
12a. DISTRIBUTION/AVAILABILITY STATEMENT  Unlimited; Approved for Public Release		12b. DISTRIBUTION CODE		
13. ABSTRACT (Maximum 200 words)  These proceedings record the results of a mini-symposium held on 2-4 March 1993. Four Working Groups, <i>Comparative Cost Analysis and Methodology</i> , <i>Uncertainty Analysis</i> , <i>Integrating Cost and Effectiveness</i> , and <i>Modeling Cost and Performance</i> convened to examine the role and methodology of cost analysis in the COEA process as well as the application of operations research techniques useful to the integration of both cost and effectiveness analysis.				
14. SUBJECT TERMS		15. NUMBER OF PAGES i - x + 46 pages		
		16. PRICE CODE		
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT  UNLIMITED	

NSN 7540-01-280-5500

Standard Form 298 (Rev. 2-89)  
Prescribed by ANSI Sta. Z39-18  
298-102

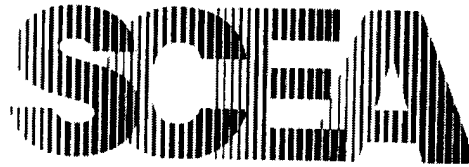
SECURITY CLASSIFICATION OF THIS PAGE

CLASSIFIED BY:

DECLASSIFIED ON:

SECURITY CLASSIFICATION OF THIS PAGE

May 14, 1996



**Military Operations  
Research Society**

**Society of Cost Estimation  
and Analysis**

**Mini-Symposium:**

**Emphasizing Cost in Cost and Operational  
Effectiveness Analyses**

**Fairfax, Virginia  
March 2 - 4, 1993**

**Donald E. Mixon, Chair**

**Report**

**Daniel A. Nussbaum, Editor**



## TABLE OF CONTENTS

Disclaimer.....	Inside front cover
Caveats.....	Inside front cover
The Military Operations Research Society.....	v
The Society of Cost Estimating and Analysis.....	vii
Preface.....	ix
1. Introduction.....	1
1.1 Background.....	1
1.2 Objectives.....	2
1.3 Organization.....	2
1.3.1 Principal Speakers.....	2
1.3.2 Working Groups.....	2
1.3.3 Panels.....	2
2. Working Group I: Comparative Cost Analysis and Methodology.....	5
2.1 Goals and Issues.....	5
2.2 Summary.....	5
3. Working Group II: Uncertainty Analysis.....	9
3.1 Goals and Issues.....	9
3.2 Summary.....	9
4. Working Group III: Integrating Cost and Effectiveness.....	11
4.1 Goals and Issues.....	11
4.2 Summary.....	11
5. Working Group IV: Modeling Cost and Performance.....	13
5.1 Goals and Issues.....	13
5.2 Summary.....	13
 <b>Appendices</b>	
1. Agenda.....	21
2. Terms of Reference.....	23
3. Participants.....	29





## **The Military Operations Research Society (MORS)**

The purpose of the Military Operations Research Society is to enhance the quality and effectiveness of classified and unclassified military operations research. To accomplish this purpose, the Society provides media for professional exchange and peer criticism among students, theoreticians, practitioners, and users of military operations research. These media consist primarily of the traditional annual MORS symposia (classified), their published proceedings and abstracts, special mini-symposia, workshops, colloquia special purpose monographs and other publications. The forum provided by these media is directed to display the state of the art, to encourage consistent professional quality, to stimulate communication and interaction between practitioners and users, and to foster the interest and development of students of operations research. In performing its function, the Military Operations Research Society does not make or advocate official policy nor does it attempt to influence the formulation of policy. Matters discussed or statements made during the course of its symposia or printed in its publications represent the positions of the individual participants and authors and not of the Society.

The Military Operations Research Society is operated by a Board of Directors consisting of 30 members, 28 of whom are elected by vote of the Board to serve a term of four years. The persons nominated for this election are normally individuals who have attained recognition and prominence in the field of military operations research and who have demonstrated an active interest in its programs and activities. The remaining two members of the Board of Directors are the Past President who serves by right and the Executive Vice President who serves as a consequence of his position. A limited number of Advisory Directors are appointed from time to time, usually a 1-year term, to perform some particular function. Since a major portion of the Society's affairs is connected with classified services to military sponsors, the Society does not have a general membership in the sense that other professional societies have them. The members of MORS are the Directors, persons who have attended a MORS meeting within the past three years and Fellows of the Society (FS) who, in recognition of their unique contributions to the Society, are elected by the Board of Directors for life.

MORS is sponsored by:

- The Deputy Under Secretary of the Army (Operations Research)
- The Director Assessment Division, Office of the Chief of Naval Operations
- The Director of Modeling, Simulation and Analysis, Deputy Chief of Staff, Plans and Operations, Headquarters, US Air Force
- Commanding General, Marine Corps Combat Development Command
- The Director of Force Structure, Resource and Assessment, The Joint Staff
- The Director Program Analysis and Evaluation, Office Secretary of Defense



# **The Society of Cost Estimating and Analysis (SCEA)**

The purpose of the Society of Cost Estimating and Analysis is to further the effectiveness and efficiency of cost estimating and analysis and related disciplines in the public and private sectors by:

- Promoting and enhancing the profession of cost estimating and analysis.
- Fostering the professional growth of its members.
- Enhancing the understanding and appreciation of cost estimating, analysis and related disciplines throughout the general public.
- Promoting a common body of knowledge as a standard for individual excellence.
- Advocating a uniform code of ethics for the profession.
- Rewarding achievement through an appropriate program of recognition and certification.
- Providing forums and media through which experiences with the principles and techniques of cost estimating and analysis may be reported, discussed and published in furtherance of public interest.
- Fostering, promoting, and conducting research and educational programs.
- Developing and maintaining standards of proficiency and performance.
- Cooperating with other organizations and individuals, having common or related purposes, in furtherance of public interest.
- Providing an opportunity for government, industry and academia to collectively discuss and comment on related, proposed or suggested subjects of common interest.
- Establishing standards in the terminology, conduct and application of cost estimating and analysis.

Membership is open to all interested individuals in the cost estimating and cost analysis professions and related disciplines.

Members are from all levels of management, are experts, journeymen, and beginners from the government, private sector and academia.



## **PREFACE**

This conference is the first conference jointly sponsored by MORS and SCEA. Both the operations research and cost communities have a mutual and overlapping interest in performing analysis required for COEAs. We, as communities, know how to do effectiveness analysis and we know how to do cost analysis. However, linking or integrating the two presents us with a unique challenge. It seemed only natural that our two communities should join forces to address the COEA costing topic, acknowledging and recognizing that we should work together to solve our common problems. It was apparent, from the other workshops and symposia on COEAs sponsored by OSD/PA&E, that integrating both types of analysis was an essential ingredient for successful completion, review and approval at the highest levels. Thus, the idea for this conference was born.



# 1. Introduction

## 1.1 BACKGROUND

During a time of rapid changes in the world and constrained resources, it is of the utmost importance that Department of Defense (DoD) decision makers be supported by pertinent and timely analysis. In an attempt to enhance and upgrade the level of analysis, the Director of Program Analysis and Evaluation, Office Secretary of Defense OSD(PA&E) developed and published Cost and Operational Effectiveness Analysis (COEA) guidelines as part of the then new 5000 Series Regulations to provide a framework for conducting COEAs.

A series of workshops was conducted to help explain the relationship of the COEA to the acquisition decision making process. The first workshop was held on 3 April 1991 at the Defense Systems Management College, Fort Belvoir, Virginia and included senior officials and analysts from DoD and the military departments. Seventy-two general officers, senior executive service civilians and others from all services met to discuss problems with current COEAs. Each workshop was opened by Dr. David Chu, ASD(PA&E). Short talks by subject matter experts were given with each followed by a brief discussion period. Each service, in turn, presented its unique problems and perceptions of the workshop.

Three "limited attendance" action officer workshops were held in May 1991, in McLean, Virginia at the MITRE Corporation with the MITRE Economic

Analysis Center serving as host. Each workshop aimed to provide a forum for working level analysts to discuss methods for improving analyses associated with COEAs. Dr. Chu provided opening comments by stressing the need for better analyses. Workshop topics were presented, again by subject matter experts.

A tutorial concerning the PA&E workshops was presented at the 1991 Annual MORS Symposium at the US Military Academy in West Point, New York. The tutorial focused on the conduct of the workshops, on issues generated from the workshops and on trends or perceptions resulting from the workshops.

A two and one-half day mini-symposium focusing on COEAs in the acquisition process was held in March 1992 in Newport, Rhode Island, with MORS serving as sponsor. Dr. Chu presented the keynote address, once again expressing the need and importance of COEAs. Congressman Ron Machtley of Rhode Island provided the luncheon address noting, in particular, the need to develop an analytical basis for allocating scarce defense resources.

Results from all workshops were reported at the 1992 Annual MORS Symposium at the Naval Postgraduate School in Monterey, California. The need to focus on the costing aspects of COEAs was highlighted during these sessions. In all the workshops, tutorials and symposiums, interest from all segments of DoD and contractor personnel was high.

## 1.2 OBJECTIVES

The objective of the MORS/SCEA mini-symposium was to examine the role and methodology of cost analysis in the COEA process as well as to examine the application of operations research techniques useful to the integration of both cost and effectiveness analysis. Exploring the broader aspect of affordability analysis is another one of the basic objectives of the mini-symposium. In particular, the goals were to:

- Understand the role of COEAs in the decision making process
- Examine the role of cost analysis in the COEA process
- Establish a set of common cost analysis issues and problems faced when performing COEAs
- Develop possible solutions or identify appropriate research areas common to those cost analysis issues and problems
- Improve the collaborative framework for dealing with COEA cost analysis requirements

## 1.3 ORGANIZATION

The mini-symposium covered a two and one-half day period and provided a forum for addressing the cost analysis issues and problems related to COEAs.

There were four major addresses, including a keynote speech by Dr. David Chu. There were two panel discussions — one a senior-level panel which addressed the general issue of cost estimating as part of the COEA process,

with emphasis on the policy perspectives of the services and OSD, and the other a mid-level panel which placed emphasis on the implementation perspectives of the services. Finally, four working groups, each addressed a specific topic area.

**1.3.1 Principal Speakers.** The principal speakers were:

- Dr. David Chu, RAND and former Assistant Secretary of Defense (Program, Analysis and Evaluation) was the keynote speaker.
- Dr. David McNicol, Deputy Assistant Secretary (Resource Analysis), OASD (PA&E), and Chairman of the Cost Analysis Improvement Group;
- Mr. Frank Kendall, Chair, Conventional Systems Committee, Defense Acquisition Board;
- Mr. Robert Soule, Deputy Director, Acquisition Resources, Acquisition Policy and Program Integration.

**1.3.2 Working Groups.** Four working groups were convened to help explain the relationship of the COEA to the acquisition decision making process. Short talks by subject matter experts were given with each followed by a brief discussion period. The four working groups were: *Comparative Cost Analysis and Methodology*, *Uncertainty Analysis*, *Integrating Cost and Effectiveness* and *Modeling Cost and Performance*.

**1.3.3 Panels.** Two panels convened following Dr. Chu's remarks. The panels consisted of representatives from each of the services' cost organizations as well as



OSD(PA&E). The panels addressed the general issue of cost estimating as part of the COEA process. Particular emphases were on the policy perspectives of the services and OSD.

Senior Panel. The Senior Panel consisted of the senior person from each of the services' cost organizations as well as OSD(PA&E). The panel addressed the general issue of cost estimating as part of the COEA process. Particular emphases were on the policy perspectives of the services and OSD.

Each of the panel members provided a senior-level perspective on the cost issues resulting from institutionalizing COEAs.

Each of the service representatives raised similar concerns and echoed the others comments. They identified workload and personnel issues as one of their primary concerns with performing "quality and credible" COEAs. They also identified the Cost Analysis Requirements Document (CARD) as a useful document for facilitating COEA costing, provided it was completed in a timely manner.

From the OSD level, one of the primary issues was ensuring the services included sufficient alternatives to substantiate the COEA results. That is, "types of system alternatives" as well as "alternatives to meeting the requirement" other than a weapon system acquisition.

Participants in the panel were:

- **Moderator** — Dr Stephen Balut, Director, Economic Analysis Center, Institute For Defense

Analyses.

- **OSD** — Dr David McNicol, Deputy Director (Resource Analysis) OSD(PA&E) and Chairman of the Cost Analysis Improvement Group (CAIG).
- **Army** — Mr. Robert Young, Director, US Army Cost and Economic Analysis Center.
- **Navy** — Captain Richard S. Coleman, Director, Naval Center for Cost Analysis.
- **Air Force** — Mr. Lee Baseman, Deputy Assistant Secretary of the Air Force (Economic Analysis)

Mid-level panel. The panel addressed issues of cost estimating as part of the COEA process. Particular emphases were on the implementation perspectives of the services. Each of the panel members provided a senior-level perspective on the cost issues resulting from institutionalizing COEAs.

Participants in the panel were:

- **Moderator** — Maj Sylvia Wardley-Niemi, Office of the Assistant Secretary of the Air Force (Financial Management).
- **Navy** — Ms. Noreen Bryant, Director of Cost Analysis, Naval Air Systems Command.
- **Army** — Dr. Herb Fallin, Director, Assessment and Evaluation, Office of the Assistant Secretary of the Army (RDA).
- **Air Force** — Mr. Jack Graser, Office of the Assistant Secretary of the Air Force (Financial Management).
- **OSD** — Mr. Lance Roark, Office of Deputy Director (Resource Analysis), OSD(PA&E).



## 2. Working Group I

### Comparative Cost Analysis and Methodology

Dr Daniel A. Nussbaum, Naval Center for Cost Analysis, and Mr. Leonard S. Freeman,  
Office Chief of Naval Operations (OP-81)

#### 2.1 GOALS AND ISSUES

Cost estimating is important and adds value to the acquisition process. In fact, the cost estimating process enhances understanding of the program by forcing greater clarity in program definition. Early involvement by the cost estimating community is critical for credible and useful COEAs. At the previous MORS mini-symposium on COEAs, everyone agreed that special emphasis should be placed on the fact that the first letter in COEA is a "C", and it stands for Cost. Without proper and early attention to cost, the COEA process is fatally flawed. The purpose of the Comparative Cost Analysis Working Group was to identify the commonly perceived problems, as well as the thoughts of the costing part of the COEA world.

This working group addressed the following issues:

- The validity of cost estimating relationships (CERs) — There is a constant need to update data bases in order to reflect current technology and acquisition environments.
- Updating cost tools — This is a continuous process requiring people and funds. Cost estimating tools are perishable as the acquisition environment changes (e.g., business base, acquisition strategy, etc.)

#### 2.2 SUMMARY

There were 10 presenters in the working group. They represented all the services in DoD and the FAA. Each speaker had actually done the cost analysis for the COEA they were presenting. The speakers provided a short overview of the COEA — the options, who did the work, and the results — and then addressed the set of common questions.

A common set of questions was discussed by each presenter, to act as a focusing agent on the working group issues.

Following the presentations, the working group analyzed the central tendency of the papers. These coalesced into a set of four issues:

- The independence of the cost estimate
- The need for a cost validation authority
- The need for an oversight board
- A gauge of the appropriate effort to be put into a COEA.

We take these four issues up, in turn, below.

The independence of the cost estimate — DoDI 5000.2 provides guidance on doing COEAs, and it requires that the cost estimates in the COEA be "consistent" with the cost estimates presented at the program's

milestone review. The working group participants believe that this consistency requirement makes it inevitable that the cost estimates that the COEA analysts use will come from the PM, and that they will be indistinguishable from the most recent POM/budget inputs from the program office. The concern of the working group participants is that consistency has replaced validity as the driving criterion.

The need for a cost validation authority — Concern about the validity of the cost estimate led to a recognition that there has to be a validating authority analogous to the independent cost estimate (ICE) required at a milestone review. Is there a validating mechanism in the Services? What we found was that:

- The Army produces an Army Cost Position (ACP), which is the result of a review of the costs in the COEA and any other cost estimates for the program. By the ACP, the Army does validate the COEA cost estimate.
- The Air Force validates its COEA cost estimates by filtering the estimates through the Air Force Cost Analysis Improvement Group (AFCAIG). In this way, the Air Force formally validates the COEA cost estimate.
- The Navy has no formal validating process. It is true that the Naval Center for Cost Analysis (NCA) serves as the Navy's independent cost estimator for milestone purposes, and sits on the Navy COEA oversight Boards (in an advisory capacity

only), and from that perch can advise on proper cost estimating standards. Nevertheless, there's no formal process in the Navy to validate the cost estimate in the COEA.

The need for an Oversight Board (OB) — Each Service has a group whose function is to oversee the accomplishment of the COEA. The Army calls it a Study Advisory Group (SAG), the Air Force calls it a COEA Advisory Board (CAG), and the Navy calls it a COEA Oversight Board (COB). Whatever it is called, almost every speaker in the working group avowed the importance of the Oversight Group, and made the following points:

- Early involvement of the OB is important to the success of the COEA.
- Active participation of the OB is very important.
- A Study Plan, briefed to and approved by the OB, is indispensable to the success of the COEA. Two of the sections of the Study Plan that were emphasized by the working group speakers were:
  - Resource section, identifying the resources (time, dollars, schedule,...) needed for the COEA.
  - Cost section, identifying the relevant cost issues to be addressed in the COEA.

A gauge of the appropriate effort for a COEA — A number of speakers emphasized the importance of making sure that the effort put into the COEA is commensurate with the problem at hand. In particular, the number of options,

paying attention to the milestone decision, and relative versus absolute costs are thought to be important issues. COEAs should be tailored to the circumstances.



## **3. Working Group II Uncertainty Analysis**

Dr Richard Trainor, US Army Cost and Economic Analysis Center

### **3.1 Goals and Issues**

Trade-offs between alternatives offering varying levels of effectiveness vis a vis different costs are specifically addressed by the COEA. The choice between competing alternatives is often aided by using uncertainty analysis. Uncertainty in the context of the symposium refers to the major factors that can be expected to adversely impact the accuracy of future cost estimates and thereby undercut the credibility of the resulting COEAs.

The working group attempted to identify these factors, describe their impact on cost analysis accuracy, identify actions required to reduce future cost analysis uncertainty and address ways of applying uncertainty analysis to COEA cost analysis.

### **3.2 Summary**

Due to the rapidly changing nature of the world, it was decided to treat the subject of uncertainty analysis in a broadly based geo-political context rather than in its more conventional mathematical orientation. Therefore this working group focused mainly on how cost analyses 10-15 years in the future will be affected by changing world events. The changes will occur gradually. However, their cumulative effect is nearly certain to be major over the long term.

Seven papers were presented in the Uncertainty Analysis Working Group. They represented the views of the Army, Navy, NASA, and both profit and non-profit analysis organizations. The content of the papers covered wide ranging topics as was appropriate to this study group.

Of the many problem areas that can be expected to cause future cost uncertainty, five were highlighted in this working group. These problem areas are the data base, the industrial base, acquisition policies, availability of CERs and the COEA workload.

The availability of a robust, applicable data base is fundamental to sound cost analyses. However, as we produce fewer weapon systems and in smaller quantities the data base shrinks accordingly. More effort is required, to include more inter service cooperation, to assure that maximum use is being made of the shrinking data base.

As the military budgets are reduced in size, we can expect to see an increasing need to assess the impact of non-recurring costs and semi-variable costs. These cost categories can be expected to attain increasing importance since companies in aerospace industry base can be expected to have difficulties in directing their talents to the development and production of "plowshares."

Emerging acquisition policies such as "silver bullets" and developing weapon systems and then "putting the technology on the shelf" may have merit. However, the emerging acquisition policies have cost implications and not all of these are obvious at first glance. The cost analysis community should take the lead to ascertain the full cost consequences of key emerging acquisition policies.

The final major problem discussed in this work group was the COEA workload. As the Department of Defense shrinks in size we can expect fewer COEAs. However, this reduction will occur very slowly, probably not as fast as reductions in the size of cost analysis staffs. Therefore, the surviving cost analysts can expect an increasing workload. Moreover, future COEAs will focus increasingly on analyses that occur during the Milestone 0 to Milestone 1 period. During this period the alternatives are poorly defined. There is no Cost Analysis Requirements Document (CARD) and top management wants the results yesterday. This dilemma, if it is to be solved, will require an entirely new cost analysis methodology. This new methodology hopefully will result in top level CERs that will allow the cost analysis community to participate in these important, but fast moving decision processes. A major research effort will be required to determine whether such top level CERs can be developed. Such research should be given a high priority within OSD and by each military department.



## **4. Working Group III**

### **Integrating Cost and Effectiveness**

Mr. Wilbur C. Hogan and Ms. Mary Henry, US Army Training and Doctrine Command (TRADOC)

#### **4.1 Goals and Issues**

The purpose of this working group was to examine various methods of integrating cost and effectiveness and to discuss their respective merits and faults. This working group was also to address how the Cost Analysis and Operations Research professions are successfully integrating cost and effectiveness analysis such that decision makers can understand and use the analysis to make decisions.

DoD 5000.2M states "there is no magic formula for combining cost and effectiveness measures to identify a preferred alternative." Accordingly, the services have been striving to come up with acceptable methods.

This working group examined those methods and discussed their merits and faults. A series of papers was presented as food for thought on different approaches to accomplishing this critical task. One series of two papers looked at Value-Added Analysis as a means of comparing two or more COEAs dealing with different means of overcoming the same deficiency or meeting the same requirement. The co-chairs presented a paper dealing with accepted methods currently used in COEAs.

this working group including representatives from the Defense Systems Management College, The MITRE Corporation, RAND, and various Army analysis organizations.

There were two central issues identified throughout the sessions. First, methods for integrating cost and effectiveness are still evolving, and second, there is "no single best method" for integration.

#### **4.2 Summary**

There were nine presentations in



## **5. Working Group IV**

### **Modeling Cost And Performance**

Dr. John G. Honig, Management Analysis Incorporated (MAI)

#### **5.1 Goals and Issues**

Cost performance analysis (as differentiated from cost effectiveness analysis) is a critical factor in design trade-off analysis of weapon systems and support equipment. A relationship of performance parameters to cost and effectiveness needs to be understood and can frequently be modeled.

This working group addressed the modeling of performance parameters and their relationship to cost and effectiveness. It was arranged into five topical sessions, which dealt with an Introduction and definition of context, Macroeconomics, Case studies, Design-to-Cost, and a General discussion session on the whole working group topic. A summary report on the working group was delivered in a final general session. In addition, at least one-half hour was set aside in each session to discuss the particular topic, and the time was generally used constructively with many working group attendees participating.

#### **5.2 Summary**

Not all "COEAs" are truly "COEAs." The early COEAs identified by Mr. Kendall are required to select the best approaches. If more than one Service can perform the mission who is the "honest broker" that defines missions, measures of effectiveness correctly and reviews that study results evenly? Rough system definitions will produce rough

operational effectiveness estimates and rough cost estimates.

Requirements documents specify performance parameters that should be met for a system to achieve a given operational effectiveness. As the operational assumptions which are the basis for the operational effectiveness change, who is responsible for analyzing the impact of the system's inherent performance on the new operational effectiveness?

As technological changes and cost constraints impact the performance parameters of a system under development, who analyzes the impact of those performance changes on operational effectiveness?

At Milestone 0 the approaches are so poorly defined that performance measures are difficult to specify. How few performance parameters is the analyst willing to accept to produce a rough estimate?

Decision makers would like to have macro parametric models that estimate costs related to performance parameters. Given the instability of CERs and the absence of good, homogenous data bases is such a process feasible?

The importance of cost analyst involvement as early in the process as possible was emphasized. The cost analyst needs to be part of the alterna-

tives definition process to assure that enough parameters are defined to be able to cost the system.

Design-to-cost will be increasingly important as budgets get tighter and each development competes with many others for scarce resources. It is important that the impact of performance changes, driven by budget constraint, on operational effectiveness be evaluated rapidly. That is, it is important to determine whether an aircraft with speed or maneuverability degradation of 15% is still operationally effective compared to the aircraft it replaces.

The cost analyst needs to work closely with the design engineers to provide responsive feedback on the impact of design changes on cost. Once a design is complete, it is sometimes difficult to incorporate changes required to lower the system's cost.

*Measures of Effectiveness* are parameters of the degree of accomplishing specified missions. These are operational measures of achieving the mission objective. These measures are a function of operational parameters to include a selection of missions to be accomplished, operational scenarios, enemy threat characteristics and tactics, strategies and tactics involved in the use of the system being analyzed and others. Operational scenarios include consideration of offensive or defensive action, daylight or night operations and others that impact the success of accomplishing a mission.

*Measures of Performance* are parameters that are intrinsic to a system, based on its design and manufacture.

These characteristics are generally measurable, e.g., air speed, altitude, cross country speed, target detection range, hit probability, etc. These measures are relatively independent of the operational scenario in which they are employed. These measures are also the ones used by engineers to design a system and, consequently are used by cost analysts to cost a system. Cost analysts do not cost operational effectiveness, they cost performance.

As operational contexts change, for example, with the demise of the Soviet threat, operational effectiveness is said to change. In reality, "effectiveness" does not change, but utility of the system changes as the threat disappears. "Operational effectiveness" can, therefore, be considered a utility measure.

As the threat changes the inherent characteristics of systems, their performance does not change, and consequently their acquisition cost does not change. If the systems utility is decreased presumably the systems operational tempo (usage) will decrease, and in a life cycle cost sense, the operating and support costs will decrease.

A key issue, that was not discussed in detail, but is an overriding factor in this discussion is the relationship between effectiveness and performance. It was stated above that the operational effectiveness changes with operational parameters. It is important to select representative operational parameters that lead to a determination of the desired performance parameters. In the test and evaluation process the performance parameters are generally measured, rather than the operational effectiveness,

although the effectiveness is considered qualitatively during the evaluation in an operational sense.

There is a corollary to this issue. As budget constraints increase severely, cost and performance tradeoffs must be analyzed. For example, how much savings can be expected if a less capable tank engine is used, decreasing cross-country speed by 15%. Someone needs to analyze the impact of this lesser speed on the operational effectiveness of the future tank.

A statement found in DoDD 5000.2, Part 4, Section E, Paragraph 3.a.(5) is:

"To judge whether an alternative is worthwhile, one must first determine *what it takes to make a difference*. *Measures of effectiveness* should be defined to measure operational capabilities *in terms of engagement or battle outcomes*. *Measures of performance*, such as weight and speed, should *relate* to the measure of effectiveness such that the effect of a change in the measure of performance can be *related* to a change in the measure of effectiveness."

In order to get insight on how cost and effectiveness are integrated Mr. Hogan, TRADOC, provided a talk on the subject. It was the same talk he also gave in his working group. His bottom line was that there is no good way of integrating cost and effectiveness. He discussed in some detail problems with determining effectiveness. He arrived at the concept of sufficiency, i.e., what is the system being analyzed supposed to accomplish, but he found no consistent methods for determining sufficiency.

The further question still remains of how to translate sufficiency into performance parameters.

Mr. Dennis, SPARTA, discussed the influence of scenarios on performance. He illustrated his talk with examples from the Strategic Defense Initiative context. He discussed the impact of attack parameters on such measures as timeliness, engagement leverage and cost per intercept. He concluded, based on his analyses, that "scenario selection can drive costs to meet requirements, by unequal focus on performance attributes."

Macroeconomics. The first talk was by LTC Loerch, US Army Concepts Analysis Agency, who presented his concept for a Value Added Analysis (VAA). He defined:

"Value Added: The incremental return on investment as measured using explicit effectiveness values and implicit effectiveness values as compared to cost.

"Explicit Measures of Effectiveness: Objective factors that measure the worth of the system/program in terms of its contribution to overall force effectiveness (e.g., combat simulation results).

"Implicit Measures of Effectiveness: Subjective factors (e.g., political risk) that affect the decision making process."

This concept was clearly and cogently presented, and is certainly useful in the overall decision making process. However, since this working group was primarily concerned with performance rather than effectiveness, and it was already stated that cost really relates to

performance, the question remains how well differences in performance of individual weapon systems, e.g., reduction in cross-country speed impact the results of VAA. Differences in performance can result from technological improvements, manufacturing difficulties and cost constraints, for example. How sensitive is the VAA methodology to analyzing alternatives with different performance characteristics.

Another comment should be made regarding the omission of operating and support costs in the optimization process. It was indicated that this estimate was difficult to arrive at because of uncertainties in estimating operating and support costs of developmental systems. On the other hand, it is well known that operating and support costs represent a major portion of the life cycle cost. Therefore estimates of operating and support costs are provided to the decision maker as information, but these costs are not included in the optimization model.

Mr. Daigle, US Army Tank and Automotive Command, discussed Analysis of Residual Value, Military Usefulness, Economic and Military Useful Life. Mr. Daigle is in the Tactical Wheeled Vehicle Fleet Planning Office and is concerned with the replacement of truck and other support vehicles. He has developed mathematical algorithms to determine the useful life of a vehicle based on cumulative maintenance costs and the investment of replacing the aging vehicle with a new vehicle of the same kind. He determined residual value and economic or militarily useful life based on operating and support costs and age characteristics of the vehicle to be

replaced.

It would appear that the applicability of Mr. Daigle's analyses are somewhat unique to his office. In his commodity are a number of critical things that do not change significantly. The missions of a truck in support of Army units, and the scenario in which they operate are rather fixed. Technological advances are generally not radical. The replacement vehicle will probably not differ significantly from the aging vehicle being replaced. It probably would be useful to analyze the feasibility of extending the basic concept to a wider variety of commodity classes.

Case Studies. Mr. Denelsbeck, Frontier Technology, Inc., lead a discussion on "Cost Architecture for Advanced Design (CAFAD)." CAFAD is an engineering-based cost architecture used for design-to-cost, tradeoffs among design alternatives, pre-Milestone 0 level costing. Its objective is to arrive at the best performance within a cost constraint. It is an automated system, uses an interdisciplinary approach, and relies on a close working relationship between the design engineers and cost analysts. It permits direct feedback when trading off performance goals and can, therefore, directly link enhanced or reduced performance to cost.

In the pre-Milestone 0 environment the designer works largely off the MENS which is frequently very general and includes performance parameters which are frequently not based on hard analyses. The relative accuracy of the cost estimates depends on the accuracy of the design parameters based on the MENS.

Mr. Denelsbeck discussed in some detail the approach that was taken to develop this cost architecture. It is based on an overall system executive routine, made up of concept, input/output and cost executive routines. Further details of each of these routines as well as the input data requirements were discussed.

In the final analysis, the model should be capable to link engineering buildups to specific engineering parameters that drive costs. The model will therefore provide costs for advanced concepts from level 0 to level 3. Cost drivers will be identified early in the process, data will be provided to support investment strategy decisions, full weapon system design and technology are inserted at the subsystem level, and the lab-wide investment planning process will be supported.

Mr. Harmon, Cost Analysis and Research Division, Institute for Defense Analyses, examined the relationship between performance and cost for various methods of integrating avionics in the next generation of tactical aircraft. The two principal methods that were compared was the traditional federated architecture of combining building blocks consisting of various electronic functions on the one hand, and a fully integrated set of avionics that incorporates the same functions in a single system on the other hand.

In the integration process decreased hardware life cycle costs are traded off against increased software life cycle costs resulting from increases in functionality. Integration will result in lower airframe and engine life cycle

costs and potential increases in weapon system effectiveness resulting from software improvements. On the cost side, the integrated system costs are due more to increased software capacity and complexity. It is expected that development costs, integration costs and support costs will all increase.

Hardware life cycle cost savings were estimated based on cost estimating relationships developed for processor weights over time (historical data), and estimating the weight of federated system architecture and the integrated system, as well as the impact of those weight differences on aircraft weight and thrust. Hardware life cycle cost savings could then be estimated.

Cost estimating relationships and other relationships were used to estimate the development cost, the integration cost and operating and support cost for integrated software. Costs were derived for physical integration (traditional federated architecture) and three levels of functional integration.

Design-To Cost. Design-to-cost was defined in DoDD 5000.28(encl. 2) as:

"Design to Cost (DTC). An acquisition management technique to achieve system designs that meet stated requirements for life cycle cost (LCC) elements. Cost is a key system consideration that is addressed on a continuing basis as an inherent part of the development and production process. The technique embodies early establishment of realistic but rigorous cost objectives, goals, and thresholds and a determined effort to achieve them".

Furthermore, the same document states that:

"The achievement of DTC parameters shall be considered as important as achievement of performance, schedule, manpower, and supportability requirements."

The above document has been superseded by a number of later publications, and DTC was finally incorporated into DoDD 5000.2. Nowhere have the above quotations been restated as clearly in later documents. However, DoDD 5000.2, Part 6, Section K, states:

"These policies and procedures establish cost as a design constraint early in the acquisition life cycle."

With increasingly tighter budget constraints, the need to develop future systems within tight cost constraints will become very important. This requires not only the capability to trade off cost and performance, but again requires understanding of how performance degradation impacts operational effectiveness.

Mr. Covert, TECOLOTE, discussed a Survivability Cost Estimating Model (SCEM), and then proceeded to demonstrate the computer model to the working group. SCEM was developed using Cost Engineering Integrated Tools (CEIT). A key factor in making this model work is a close integration of the design and cost analysis process. The latter is considered an integral part of the systems engineering process. Rather than being handed a system to cost, after having been completely designed, the cost analyst works with the engineer every step of the way.

In the application shown, SCEM was applied to Javelin. Hardening techniques to counter nuclear and laser threats were examined. Each subsystem had a suite of hardening options that could be selected, and each selection had performance, weight and cost impact. By modeling these factors explicitly the impact of design changes could be readily determined. By combining system design logic with cost estimating technologies the decision maker could make cost-conscious decisions concerning each hardening technique on an element-by-element basis.

General Discussion. The last session provided an opportunity for spirited discussion among many of the working group attendees. It became evident that not all COEAs are "true COEAs". Mr. Kendall, in his luncheon speech pointed out the need for more "COEA" prior to milestone 0. This brought out a number of issues.

If the mission has the potential of being performed by more than one Service who is responsible for a Super-COEA, who assures that each of the Service candidates are analyzed on a comparable basis, performs an independent risk analysis, and measures that the costs are comparable?

Milestone 0 analyses lead to specification of operational effectiveness and performance parameters. In most cases there may only be very few of these performance parameters and they are based on little analysis. Even the effectiveness analyses are macro, yet the expectations of the cost estimate are of a valid, tight estimate. A key issue facing the cost analyst is, on the basis of how



few performance parameters, will he be willing to put a cost estimate on paper. He must also consider that costs have a life of their own, and whatever assumptions he makes may be forgotten when the costs are quoted in the *Washington Post*.

A related subject deals with relative cost estimates. Early in the design cycle it may only be possible to have rough estimates of the relative cost of various approaches. This may be adequate to choose an alternative, but it is not adequate to determine its affordability. It may be that none of the alternatives are affordable with serious redesign within DTC constraints.

If technological or cost risks find an alternative to be too risky and has to be redesigned, who will reassess the operational effectiveness of the degraded performance system? Who determines that, given this degradation, how the rank ordering of the alternatives changes?

The 1992 COEA conference identified the following methodological issue:

"Better Macro Level Parametric Cost Models are Needed."

The same item continues:

"Parametric Macro Cost Models — Performance Parameter Based — are needed to allow cost trades."

The answer proposed was to "develop quick response methodologies, new macro level models with performance parameters available by acquisition

phase, and by commodity class."

There was no more discussion about the desirability of such models than the desirability of motherhood. However, there was little consensus about even the feasibility of such models with a reasonably acceptable degree of uncertainty.

It is evident that development of such macro models requires cost estimating relationships that continue to be valid over time and that are based on reasonably homogeneous data bases. There was consensus that neither of these are in existence, nor likely to be happening. With rapidly advancing technologies and irregular trend lines, extrapolating CERs based on historical data is speculative at best.

Greg Staley, Air Force ASC/XRE, discussed his organization's cost engineering process, whereby design and cost estimates are developed simultaneously. He discussed the advantages of a joint Air Force-Industry Life Cycle Cost Engineering Working Group. He also emphasized the importance of performance impact on operating and support costs. He also emphasized the importance of XR working with the using command to refine the requirement to have designable/costable parameters.



# **Appendix 1**

## **Agenda**

### **2 March 1993**

- 0730-0830**     **Registration (Coffee, Pastries, Juices)**  
**0830-0845**     **Welcome / Introduction of Keynote Speaker**  
**0845-0930**     **KEYNOTE ADDRESS — Dr. David Chu, RAND Corp; formerly Assistant Secretary of Defense, Program Analysis and Evaluation**  
**0930-1000**     **BREAK**  
**1000-1200**     **SENIOR-LEVEL PANEL DISCUSSION — "OSD CAIG and Military Departments Response to COEA Costing", moderated by Dr. Steven Balut, Institute for Defense Analysis**  
**1200-1330**     **LUNCHEON with SPEAKER (Dr. McNicol)**  
**1330-1530**     **GENERAL SESSION: MID-LEVEL PANEL DISCUSSION — "Issues in COEA Cost Analysis"**  
**1530-1600**     **BREAK**  
**1600-1700**     **GENERAL SESSION: AFFORDABILITY ANALYSIS — Robert Soule, Office of the Assistant Secretary of Defense, Acquisition.**

### **3 March 1993**

- 0800-1000**     **CONCURRENT WORKING GROUPS**  
                  **Comparative Cost Analysis and Methodology (Dr. Nussbaum and Mr. Freeman)**  
                  **Uncertainty Analysis (Dr. Trainor)**  
                  **Integrating Cost and Effectiveness (Mr. Hogan and Ms. Henry)**  
                  **Modeling Cost and Performance (Dr. Honig)**  
**1000-1030**     **BREAK**  
**1030-1200**     **CONCURRENT WORKING GROUPS**  
**1200-1330**     **LUNCHEON With SPEAKER (Mr. Frank Kendall III)**  
**1330-1500**     **CONCURRENT WORKING GROUPS**  
**1500-1530**     **BREAK**  
**1530-1700**     **CONCURRENT WORKING GROUPS**

### **4 March 1993**

- 0800-1000**     **CONCURRENT WORKING GROUPS**  
**1000-1030**     **BREAK**  
**1030-1200**     **CONCURRENT WORKING GROUPS**  
**1200-1300**     **LUNCH**  
**1300-1500**     **WORKING GROUP REPORTS**  
**1500-1530**     **CLOSING REMARKS**



## **Appendix 2**

### **TERMS OF REFERENCE**

#### **BACKGROUND**

During a time of rapid changes in the world and constrained resources, it is of the utmost importance that Department of Defense (DoD) decision makers are supported by pertinent and timely analysis. In an attempt to enhance and upgrade the level of analysis, OSD/PA&E developed and published COEA guidelines as part of the new 5000 Series Regulations to provide a framework for conducting COEAs.

A series of workshops was conducted to help explain the relationship of the COEA to the acquisition decision making process. The first workshop was held on 3 April 1991 at the Defense Systems Management College, Fort Belvoir, Virginia and included senior officials and analysts from DoD and the military departments. Seventy-two general officers, senior executive service civilians and others from all services met to discuss problems with current COEAs. The workshops were opened by Dr. David Chu, ASD(PA&E). Short talks by subject matter experts were given with each followed by a brief discussion period. Each service, in turn, presented its unique problems, and perceptions of the workshop.

Three "limited attendance" action officer workshops were held in May 1991, in McLean, Virginia with the MITRE Corporation serving as host. Each workshop aimed to provide a forum for working level analysts to discuss methods for improving analyses associated with COEAs. Dr. Chu provided opening comments by stressing the need for better analyses. Workshop topics were presented, again by subject matter experts.

A tutorial concerning the PA&E workshops was presented at the 1991 Annual MORS Symposium at the US Military Academy in West Point, New York. The tutorial focused on the conduct of the workshops, on issues generated from the workshops and on trends or perceptions resulting from the workshops.

A two and one-half day mini-symposium focusing on COEAs in the acquisition process was held in March 1992 in Newport, Rhode Island, with MORS serving as sponsor. Dr. Chu presented the keynote address, once again expressing the need and importance of COEAs. Congressman Ron Machtley of Rhode Island provided the luncheon address noting, in particular, the need to develop an analytical basis for allocating scarce defense resources.

Results from all workshops were reported to the 1992 Annual MORS Symposium at the Naval Postgraduate School in Monterey, California. The need to focus on the costing aspects of COEAs was highlighted during these sessions. In all the workshops,

tutorials and symposia, interest from all segments of DoD and contractor personnel has been high.

## **OBJECTIVE**

The objective of the mini-symposium will be to examine the role and methodology of cost analysis in the COEA process as well as the application of operations research techniques useful to the integration of both cost and effectiveness analysis. Exploring the broader aspect of affordability analysis is another one of the basic objectives of the mini-symposium. In particular, the goals are to:

- Understand the role of COEAs in the decision making process;
- Examine the role of cost analysis in the COEA process;
- Establish a set of common cost analysis issues and problems faced when performing COEAs;
- Develop possible solutions or identify appropriate research areas common to those cost analysis issues and problems;
- Improve the collaborative framework for dealing with COEA cost analysis requirements.

## **SCOPE**

The mini-symposium will cover a two and one-half day period and will provide a forum for addressing the cost analysis issues and problems related to COEAs. Dr. David Chu will be the keynote speaker. In addition, there will be a high-level government panel comprised of the Chairman of the OSD Cost Analysis Improvement Group (CAIG) and the senior cost analysis officials from each of the three services. The panel will address "OSD CAIG and Military Department response to COEA Cost Analysis." Each official will give a fifteen to twenty minute presentation, followed by a fifteen to twenty minute period of questions.

Working groups on special topic areas will be conducted in which presentations will be given by practitioners within the operations research and cost analysis communities. The working groups will be held on the morning of the second day of the symposium and repeated during the afternoon of the same day to give attendees an opportunity to participate in more than one working group session.

The mini-symposium chair will select co-chairs from each services' cost centers as well as co-chairs of the working groups for the special topic areas. The co-chairs will in turn, solicit speakers to give presentations on each of the special topic areas in working groups. The speakers will themselves be experts within their respective areas and will

present areas to explore and discuss the COEA issues facing cost analysis practitioners. The special topic areas to be explored are:

- Issues in COEA Cost Analysis
- Methodology for Comparative Cost Analysis
- Uncertainty Analysis
- Integrating Cost and Effectiveness
- Modeling Cost and Performance

#### Issues in COEA Cost Analysis

This general session will serve, to some extent, as an overview to the more detailed working group sessions which will take place on the second day of the mini-symposium. Hence, this special topic area will be addressed before the entire mini-symposium audience. Speakers from OSD and each of the three services will explain which government organizations are doing cost analysis for COEAs and will discuss their approaches, issues and problems.

#### Methodology for Comparative Cost Analysis

Cost estimating is important and adds value to the acquisition process. In fact, the cost estimating process enhances understanding of the program by forcing greater clarity in program definition. Early involvement by the cost estimating community is critical for credible and useful COEAs.

At the last MORS mini-symposium on COEAs, everyone agreed that special emphasis should be placed on the fact that the first letter in COEA is a "C", and it stands for Cost. Without proper and early attention to cost, the COEA process is fatally flawed.

This working group will address the following issues:

- The validity of cost estimating relationships (CERs) — There is a constant need to update data bases in order to reflect current technology and acquisition environments.
- Updating cost tools — This is a continuous process requiring people and funds. Cost estimating tools are perishable as the acquisition environment changes (e.g., business base, acquisition strategy, etc.)

### Uncertainty Analysis

Trade-offs between alternatives offering varying levels of effectiveness vis a vis different costs are specifically addressed by the COEA. The choice between competing alternatives is often aided by using uncertainty analysis. Uncertainty in the context of the symposium refers to the major factors that can be expected to adversely impact the accuracy of future cost estimates and thereby undercut the credibility of the resulting COEAs.

This working group will attempt to identify these factors, describe their impact on cost analysis accuracy, identify actions required to reduce future cost analysis uncertainty and address ways of applying uncertainty analysis to COEA cost analysis. This working groups will involve four speakers.

### Integrating Cost and Effectiveness

DoD 5000.2M states "there is no magic formula for combining cost and effectiveness measures to identify a preferred alternative." Accordingly, the services have been striving to come up with acceptable methods.

This working group will examine those methods and discuss their merits and faults. A series of papers will be presented as food for thought on different approaches to accomplishing this critical task. One series of two papers will look at Value-Added Analysis as a means of comparing two or more COEAs dealing with different means of overcoming the same deficiency or meeting the same requirement. The co-chairs will present a paper dealing with accepted methods currently used in COEAs.

### Modeling Cost and Performance

Description still to come.

## **PARTICIPATION**

Attendance will be limited to a maximum of 300 people. The goal is to get people currently involved in costing, analyzing and modeling activities associated with COEAs and those responsible for providing oversight of the COEA and its analytical methodologies. The symposium will be at the unclassified level.

## **DATE AND LOCATION**

The mini-symposium will be held March 2-4, 1992 at the Fairview Park Marriott Hotel, Falls Church, Virginia.



## **LUNCHEON SPEAKER**

A luncheon will be held at the Fairview Park Marriott Hotel on each day of the symposium. A high-level Government official will be invited to address the attendees on the theme of the symposium or other pertinent topic relative to the symposium theme.

## **PRICE**

The registration fee for the mini-symposium will be \$150.00 for Government personnel and \$300.00 for non-government personnel.

## **PRODUCT**

The product from this mini-symposium will include the abstracts from the papers presented during the special-topic working groups prepared by the presenter. It will also include a summary of each working group and general session done by the session chair. Each presenter will prepare the abstract to be included in the published proceedings jointly published by MORS and SCEA.

## **ORGANIZING COMMITTEE**

### **General Chair**

Mr. Donald E. Mixon  
The MITRE Corporation  
(703) 883-6599 FAX: (703) 883-5963

### **Deputy Chairs**

Dr. Al Diaz  
Office of the Secretary of Defense, Program Analysis and Evaluation  
(703) 697-9141 FAX: (703) 693-5707

Dr. Gerald McNichols  
Management Consulting and Research  
(703) 820-4600 FAX: (703) 820-4398

### **Co-Chairs (Working Group Chairs)**

#### **Issues in COEA Cost Analysis**

Lance Roark, OSD (PA&E)  
(703) 693-7827; FAX (703) 693-5707

MAJ Sylvia Wardley-Niemi  
Air Force Cost Center  
(703) 697-2331; FAX (703) 614-9873

**Methodology for Comparative Cost Analysis**

Dr. Daniel Nussbaum, Naval Center for Cost Analysis  
(703) 746-2327; FAX (703) 746-2390

**Uncertainty Analysis**

Dr. Richard J. Trainor, US Army Cost and Economic Analysis Center  
(703) 756-1861; FAX (703) 756-8732

**Modeling Cost and Performance**

Chair TBD

**Integrating Cost and Effectiveness**

Wilbur C. Hogan, III and Mary Henry  
US Army Training and Doctrine Command  
(804) 728-5803; FAX (804) 727-4394

**Other Members**

Mr. Leroy T. Baseman  
SCEA, Executive Director  
Chairman, Air Force Cost Analysis Improvement Group (AFCAIG)

Ms. Natalie S. Addison  
MORS, Associate Executive Director

Dr. Tom Gullledge  
George Mason University

Dr. David Lee  
OSD, Program Analysis and Evaluation

Ms. Joan Lovelace  
MITRE Corporation

Major Verna McBride  
HQ AFSAA

Ms. Debbie J. Vogel  
SCEA National Office

Mr. Richard I. Wiles  
MORS, Executive Director

## Appendix 2

### Participants\*

Brad Adams  
Analytical Services, Inc (ANSER)  
1215 Jefferson Davis Highway  
Suite 800  
Arlington VA 22202  
OFF TEL: (703)-685-3289  
FAX: (703)-685-3225

Doug Adams  
Center for Naval Analyses  
4401 Ford Ave  
P.O. Box 16268  
Alexandria VA 22302-0268  
OFF TEL: (703)-824-2255  
FAX: (703)-824-2949

James L Adams  
ASC/YXF  
Bldg 2041  
2511 L Street  
Wright-Patterson AFB OH 45433-7503  
OFF TEL: (513)-255-4216 DSN: 785-4216  
FAX: (513)-785-8381  
E-mail: adamsjl

Mark J Adams  
TRW One Space Park  
Bldg 01, Room 1271  
Redondo Beach CA 90278  
OFF TEL: (310)-814-6858  
FAX: (310)-813-1642

Scott M Allard  
Management Consulting & Research, Inc.  
Suite 300  
1505 Farm Credit Drive  
McLean VA 22102  
OFF TEL: (703)-506-4600  
FAX: (703)-820-4398

Harold E Alston  
US Army Intelligence Threat Analysis Ctr  
ATTN: AIAIT-RTM  
Bldg 213, Stop 314  
Washington Navy Yard DC 20374-5085  
OFF TEL: (202)-479-1936 DSN: 335-2625  
FAX: (202)-488-8846

DR Michael R Anderberg  
OSD PA&E  
Rm 2D278 Pentagon  
Washington DC 20301-1800  
OFF TEL: (703)-697-0317 DSN: 227-0317  
FAX: (703)-693-5707

Denise M Anderson  
Naval Air Systems Command  
Washington DC 20361-5260  
OFF TEL: (703)-692-1198 DSN: 222-3443  
FAX: (703)-746-2965

John C Anderson  
Consultant  
OFF TEL: (703)-971-7144

Kathleen A Anderson  
VEDA, Inc  
5100 Springfield Pike, Suite 320  
Dayton OH 45431-1289  
OFF TEL: (513)-476-3250  
FAX: (513)-256-1673

MAJ Timothy R Ascani  
US Army Cost & Economic Analysis Center  
5611 Columbia Pike  
Falls Church VA 22041-5050  
OFF TEL: (703)-756-0349 DSN: 289-0349  
FAX: (703)-756-7552

---

\* Addresses as of April 6, 1996.

Eileen L Ashby  
Marine Corps Rsch Development & Acq Comd  
Code C2A  
2033 Barnett Ave, Suite 315  
Quantico VA 22134-5080  
OFF TEL: (703)-640-2645 DSN: 278-2645  
FAX: (703)-640-2655

Larry L Austin  
SAIC  
POB 46565  
Washington DC 20050  
OFF TEL: (703)-693-0410 DSN: 223-0410  
FAX: (703)-693-1161  
E-mail: postlla@aol.com

Mark H Awtry  
TASC  
55 Walkers Brook Drive  
Reading MA 01867  
OFF TEL: (617)-642-2000  
FAX: (617)-944-3138

CDR Dennis R. Baer  
Naval Center for Cost Analysis  
NCA-54  
1111 Jefferson Davis Hwy, Suite 400  
Arlington VA 22202-4306  
OFF TEL: (703)-604-0307 DSN: 664-0307  
FAX: (703)-604-0315  
E-mail: dbaer@dmso.dtic.dla.mil

William Baker  
Naval Air Systems Command  
1421 Jefferson Davis Highway  
Washington DC 20361  
OFF TEL: (703)-692-9182 DSN: 222-9182  
FAX: (703)-692-9600

Capt John Barth

Harry J Bartosik  
Vanguard Research Inc  
Suite 450  
10306 Eaton Place  
Fairfax VA 22030-2201  
OFF TEL: (703)-934-6300  
FAX: (703)-273-9398

Leroy T Baseman III  
SAF/ACC  
Pentagon, Room 4D159  
Washington DC 20330-5018  
OFF TEL: (202)-693-0792

Heidi W Baskin  
HQ ACC/FMAMB  
216 Sweeney Blvd  
Suite 212  
Langley AFB VA 23665-2792  
OFF TEL: (804)-764-5431 DSN: 574-5431

Larry J Beasley  
HQ ASC/XPE  
Wright-Patterson AFB OH 45433-6503  
OFF TEL: (513)-255-4377 DSN: 785-4377  
FAX: (513)-255-0650

Harold E Bechthold  
HQ AFSPACCOM/FMAL  
150 Vandenberg Street, #1105  
Peterson AFB CO 80914-4010  
OFF TEL: (719)-554-5661 DSN: 692-5661  
FAX: (719)-554-3648

Peter M Beck  
Decision Technology  
Suite 903  
1300 Crystal Drive  
Arlington VA 22209  
OFF TEL: (703)-416-2523  
FAX: (703)-416-2523  
E-mail: pmbeck@ix.netcom.com

Emmet R Beeker  
GRC International Inc.  
1900 Gallows Road  
Vienna VA 22182  
OFF TEL: (703)-695-0350 DSN: 225-0350  
E-mail: ebeeker@grci.com

James R Behne  
TRADOC Analysis Command-Lee  
Attn: ATRC-LS  
401 First Street  
Fort Lee VA 23801-6000  
OFF TEL: (804)-765-1838 DSN: 539-1838  
FAX: (804)-539-1456  
E-mail: behnej@trac.army.mil

Mary T Benze  
Office of Aerospace Studies  
COEA Support Division  
3550 Aberdeen SE  
Kirtland AFB NM 87117  
OFF TEL: (505)-846-8302 DSN: 246-8302  
FAX: (505)-846-4668

Robert J Bielgaski  
Naval Surface Warfare Center  
WO Det  
Silver Spring MD 20903  
OFF TEL: (301)-394-2110 DSN: 290-2110  
FAX: (301)-394-4722

Steven M Biemer  
Johns Hopkins University/APL  
Applied Physics Laboratory  
Johns Hopkins Road  
Laurel MD 20723  
OFF TEL: (301)-953-8605  
FAX: (301)-953-5910

Robert L Black

Gary R. Bliss  
OSD (PA&E)  
Pentagon Room 2C310  
Washington DC 20301-1800  
OFF TEL: (703)-695-4348 DSN: 227-2999  
FAX: (703)-693-5707

Mark S Blouin

MAJ Roger D Bohnke  
HQ ACC/FMA  
216 Sweeney Blvd  
Ste 212  
Langley AFB VA 23665-2792  
OFF TEL: (804)-764-5431 DSN: 574-5431  
FAX: (804)-764-7560

Raymond D Borkowski  
Naval Air Systems Command  
Washington DC 20361-5245  
OFF TEL: (703)-692-7688  
Ext: 2616  
FAX: (703)-692-9600

Ronald S Bowen  
Tecolote Research Inc  
54 Middlesex Turnpike  
Bedford MA 01730-1475  
OFF TEL: (617)-275-3014  
FAX: (617)-275-3407

CDR Benjamin F Breaux  
Naval Center for Cost Analysis  
1111 Jefferson Davis Hwy  
Suite 400 West Tower  
Arlington VA 22202-4306  
OFF TEL: (703)-604-0289 DSN: 664-0289  
FAX: (703)-604-0289  
E-mail:  
breaux.benjamin\_at\_nca@hq.secnau.navy.m

Steven W Brennan  
Space and Naval Warfare Systems Com  
Architecture & Engineering Dir (311-5)  
2451 Crystal Drive  
Arlington VA 22245-5200  
OFF TEL: (703)-602-1724 DSN: 332-1724  
FAX: (703)-602-5891  
E-mail: brennans@smtp-gw.spawar.navy.mil

Terry A Bresnick

Fritz H Brinck  
Naval Surface Warfare Center  
Dahlgren Division  
Code A51  
Dahlgren VA 22448-5100  
OFF TEL: (703)-663-7369  
FAX: (703)-663-7898

William A Brinkley  
Teledyne Brown Engineering  
PO Box 070007  
300 Sparkman Dr, MS 170  
Huntsville AL 35807-7007  
OFF TEL: (205)-726-5857  
FAX: (205)-726-2241  
E-mail: tony.brinkley@pobox.tbe.com

CPT John D Bryant  
US Army Total Cost & Econ Analysis Ctr  
5611 Columbia Pike  
Room 420  
Falls Church VA 22041-5050  
OFF TEL: (703)-756-0335 DSN: 284-0335  
FAX: (703)-756-2625

Larry Buchsbaum  
Naval Air Warfare Center  
A/C Division, Code 4.1OD MS86  
PO Box 5152  
Warminster PA 18974-0591  
OFF TEL: (215)-441-1534 DSN: 441-1534  
FAX: (215)-441-3932  
E-mail: buksbaum@nadc.navy.mil

William C Burnham  
US Army Logistics Management College  
Decision Sciences Dept  
Fort Lee VA 23801-6050  
OFF TEL: (804)-765-4733 DSN: 539-4733  
FAX: (804)-765-4648

Marvin E Cahill  
The Analytic Sciences Corp (TASC)  
2555 University Blvd  
Fairborn OH 45324  
OFF TEL: (513)-426-1040  
FAX: (513)-426-8888

Roger H Caldow  
Johns Hopkins University/APL  
Johns Hopkins Road  
Laurel MD 20723  
OFF TEL: (301)-953-5039  
FAX: (301)-953-9450

Joseph C Calpin  
The MITRE Corporation  
Suite 401, Crystal Square 4  
1745 Jefferson Davis Highway  
Arlington VA 22202  
OFF TEL: (703)-412-8915

Jackson G Calvert  
US Army Space & Strategic Defense Com  
Attn: CSSD-  
PO Box 1500-PI-C  
Huntsville AL 35802  
OFF TEL: (205)-955-4923 DSN: 695-4923  
FAX: (205)-955-4522

Daniel L Carbo  
Naval Air Warfare Center  
Aircraft Div-Warminster, Code 3033  
Street and Jacksonville Rds  
Warminster PA 18974-5000  
OFF TEL: (215)-441-7006 DSN: 441-7006  
FAX: (215)-441-1967  
E-mail: dancarbo@nadc.navy.mil

Joseph P Cardarelli  
NAVAIRSYSCOM  
AIR-524  
Washington DC 20361  
OFF TEL: (703)-692-7688  
Ext: 2625  
FAX: (703)-692-9600

Amanda JA Cardiel  
NAVSURFWARCENDIV  
17320 Dahlgren Rd  
A-51  
Dahlgren VA 22448-5100  
OFF TEL: (703)-663-7369 DSN: 249-7369  
FAX: (703)-663-7898

Mary JoAnn Carroll  
AFSAA/SAM  
1570 Air Force Pentagon  
Washington DC 20330-1570  
OFF TEL: (703)-697-1622 DSN: 227-6902  
FAX: (703)-697-3441  
E-mail: carroll@afsaa.hq.af.mil

Jim Cha

Brian Chappel  
Tecolote Research, Inc  
3601 Aviation Blvd  
Suite 1600  
Manhattan Beach CA 90266  
OFF TEL: (310)-536-0011  
FAX: (310)-536-9922

E. Christophe Chartier  
Naval Air Systems Command  
Washington DC 20361-5260  
OFF TEL: (703)-692-3447  
FAX: (703)-746-2965

DR David S C Chu  
RAND  
2100 M Street, NW  
Washington DC 20037  
OFF TEL: (202)-296-5000  
FAX: (202)-296-7960

Mark W Clark  
Martin Marietta Air Traffic Systems  
475 School Street, SW  
MS-V62  
Washington DC 20024  
OFF TEL: (202)-646-5826  
FAX: (202)-646-2255

Richard G Cline  
Rockwell International  
12214 Lakewood Blvd  
Mail Code: SX05  
Downey CA 90241  
OFF TEL: (310)-797-1060  
FAX: (310)-797-1516

Capt Richard L Coleman (Ret.)

Craig E College  
OSD (PA&E)  
The Pentagon, Room 2D311  
Washington DC 20301-1800  
OFF TEL: (703)-697-2936

LCDR Justin J Comstock  
Secretary of the Air Force  
Space Systems  
The Pentagon 4C1052  
Washington DC 20370  
OFF TEL: (703)-614-0404

Timothy C. Coons  
Sverdrup Technologies, Inc  
4200 Col. Glenn Highway, Suite 500  
Dayton OH 45431  
OFF TEL: (513)-476-4824 DSN: 986-4824  
FAX: (513)-476-4658

Raymond P Covert  
Tecalote Research Inc.  
3601 Aviation Blvd., #1600  
Manhattan Beach CA 90266  
OFF TEL: (310)-536-0011

Kenneth E Cox  
General Dynamics  
3190 Fairview Park Drive, #1  
Falls Church VA 22042-4523  
OFF TEL: (703)-284-9230  
FAX: (703)-284-9244

Lianna Cruz  
JWAC  
18385 Frontage Road  
Code JN61  
Dahlgren VA 22448-5500  
OFF TEL: (703)-663-1892 DSN: 249-1892

Dianne M Cutshaw  
MARCORSSYSCOM  
Code PSA-O  
2033 Barnett Ave, Suite 315  
Quantico VA 22134-5010  
OFF TEL: (703)-640-4455 DSN: 278-4455  
FAX: (703)-640-2168

L. Patrick Cyrus  
USAF ASC/XRPC  
Bldg 450  
Wright-Patterson AFB OH 45433  
OFF TEL: (513)-255-5288 DSN: 785-5288  
FAX: (513)-476-7155

Karl R Dahlen  
Military Professional Resources Inc.  
Hotel Chamberlin, Suite 701  
PO Box 12  
Fort Monroe VA 23651  
OFF TEL: (804)-723-8053  
FAX: (804)-723-4089

Robert A Daigle  
US Army TACOM  
Fleet Planning Office  
AMSTA-TR-D (MS 162)  
Warren MI 48397-5000  
OFF TEL: (313)-574-6703 DSN: 786-6703  
FAX: (810)-574-5201  
E-mail: daigleb@tacom-emh165.army.mil

Tung M Dang  
US Army PEO-GPALS  
P.O. Box 1500  
Attn: SFAE-GPL-GBR-P  
Huntsville AL 35807  
OFF TEL: (205)-955-5992 DSN: 645-5992  
FAX: (205)-955-1867

DR Dale M Dannhaus  
US Army TRAC-WSMR  
Attn: ATRC-WD  
White Sands Missile Range NM 88002  
OFF TEL: (505)-678-4617 DSN: 258-4617  
FAX: (505)-678-5104

Elizabeth A Davies  
Army Logistics Management College  
ALMC  
Fort Lee VA 23801  
OFF TEL: (804)-765-4250 DSN: 539-4250  
FAX: (804)-765-4648

Frank Doiron

Maryann P Dominiak  
HQ AMC  
Attn: AMCRM-E  
5001 Eisenhower Ave  
Alexandria VA 22333-0001  
OFF TEL: (703)-274-9082 DSN: 284-9082  
FAX: (703)-274-8425

Capt Stuart L Dornfeld  
ESC/TGN  
11 Eglin Street  
Hanscom AFB MA 01731-2120  
OFF TEL: (617)-377-8928 DSN: 478-8928  
FAX: (617)-377-7447

Eugene R Douglas  
Martin Marietta Air Traffic Systems  
475 School Street, SW  
MS-V62  
Washington DC 20024  
OFF TEL: (202)-646-5813  
FAX: (202)-646-2255

Dennis L Doyle  
PRC, Inc  
2750 Killarney Drive  
Suite 200  
Woodbridge VA 22192  
OFF TEL: (703)-730-1951  
FAX: (703)-730-1960

Hubert W Drake  
ASI Systems International  
825 N Downs, Suite C  
China Lake CA 93555  
OFF TEL: (619)-375-1442  
FAX: (619)-375-0230

Katherine F Drew  
Naval Surface Warfare Center  
Code U31  
Silver Spring MD 20903-5000  
OFF TEL: (202)-394-1457 DSN: 290-1457  
FAX: (202)-394-1164

Kristina J Ennis  
Carderock Division/NSWC  
Code 1210  
Bethesda MD 20084-5000  
OFF TEL: (301)-227-4699  
FAX: (301)-227-1038  
E-mail: ennis@oasys.dt.navy.mil

DR Henry L Eskew  
Center for Naval Analyses  
4401 Ford Ave  
Alexandria VA 22302  
OFF TEL: (703)-824-2254 DSN: 289-2638  
FAX: (703)-824-2949

CDR Melvin R Etheridge (Ret)  
Logistics Management Institute  
6400 Goldsboro Rd  
Bethesda MD 20817-5886  
OFF TEL: (301)-320-7307  
FAX: (301)-320-5617

Ross Fairbrother  
SAIC  
1213 Jefferson Davis Highway  
Arlington VA 22202  
OFF TEL: (703)-553-6152  
FAX: (703)-979-2707

DR Herbert K Fallin Jr  
OASA(RDA)  
SARD-ZD, Room 2E673  
103 Army Pentagon  
Washington DC 20310-0103  
OFF TEL: (703)-697-2653 DSN: 227-2653  
FAX: (703)-695-9069  
E-mail: calahab@pentagon.hqdadss.army.mil

Louie F Feher-Peiker  
NetBase Corporation  
Ste 450  
12110 Sunset Hills Road  
Reston VA 22090  
OFF TEL: (703)-715-3033  
FAX: (703)-709-6195

LCDR John H Fenter  
COMOPTEVFOR  
7970 Diven St  
Norfolk VA 23505-1498  
OFF TEL: (804)-444-2954 DSN: 564-2954  
FAX: (804)-565-8516  
E-mail: fenter@tecnet1.jcte.jcs.mil



Russell F Feury  
US Army Tank Automotive Command  
ATTN: AMSTA-RM-V  
Warren MI 48397-5000  
OFF TEL: (810)-574-6154 DSN: 786-6154  
FAX: (810)-574-8620

Carole M Fischer  
US Army TACOM Fleet Planning Office  
AMSTA-CM-S  
Warren MI 48397-5000  
OFF TEL: (313)-574-6704 DSN: 786-6704  
FAX: (313)-574-5201

Lewis P Fisher  
Martin Marietta Air Traffic Systems  
MS V-62  
475 School St, SW  
Washington DC 20024  
OFF TEL: (202)-646-5897  
FAX: (202)-646-2255

Dale N Fletcher  
Research, Development and Acquisition  
Program Evaluation Rm 2E673  
103 Army Pentagon  
Washington DC 20310-0103  
OFF TEL: (703)-695-7239 DSN: 225-7239  
FAX: (703)-695-9069

Beverley K Folk  
US Army Tank Automotive Command  
Fleet Planning Office  
Attn: AMSTA-CM-S  
Warren MI 48397-5000  
OFF TEL: (810)-574-6703 DSN: 786-6703  
FAX: (810)-574-5201  
E-mail: folkk@tacom-emh165.army.mil

Elizabeth A Ford

DR Roger A Forder  
UK Ministry of Defence  
Room 2314, MOD Maind Bldg  
Whitehall, London, SW1A 2HB, UK

Roger A Francis  
Horizons Technology Inc  
700 Technology Park Drive  
Billerica MA 01821-4196  
OFF TEL: (508)-663-6600  
FAX: (508)-663-8357

Leonard S Freeman  
Office of the Chief of Naval Operations  
(N810T)  
2000 Navy Pentagon  
Washington DC 20350-2000  
OFF TEL: (703)-614-7271 DSN: 224-7271  
FAX: (703)-693-9760

MAJ Steven A Gaioni

Betty H Gay

Donald L Giadrosich

Melisa H Gilbert  
USASSDC  
PO Box 1500  
Huntsville AL 35807-3801  
OFF TEL: (205)-955-5464 DSN: 645-5464

Patricia M Gilcrest  
US Army Total Cost & Econ Analysis Ctr  
5611 Columbia Pike  
Falls Church VA 22041-5050  
OFF TEL: (703)-756-0326 DSN: 289-0326  
FAX: (703)-756-2601

Robert Gillan  
Defense Research Agency  
Room 123A, Main Building, DRA Portsdown  
Portsmouth, P064AA, ENGLAND  
OFF TEL: 011 44 705 333 599  
FAX: 011 44 705 333 769

Stephen N Glass  
General Research Corporation  
1900 Gallows Road  
Vienna VA 22182  
OFF TEL: (703)-693-4137  
FAX: (703)-506-9241  
E-mail: glass@grci.com

Alan R Glazman  
Naval Surface Warfare Center  
Code A50  
Dahlgren Division  
Dahlgren VA 22448-5000  
OFF TEL: (703)-663-7369 DSN: 249-7369  
FAX: (703)-663-7898

David A Goldammer  
McDonnell Douglas Aerospace  
PO Box 516  
MC 0642513  
St. Louis MO 63166-0516  
OFF TEL: (314)-777-9224  
FAX: (314)-777-9511

Matthew S Goldberg  
Institute for Defense Analyses  
1801 N. Beauregard Street  
Alexandria VA 22311-1772  
OFF TEL: (703)-845-2099  
FAX: (703)-845-2211  
E-mail: mgoldber@ida.org

Aaron Goldfarb  
PEO(TAD)  
2531 Jefferson Davis Highway  
Arlington VA 22242-5170  
OFF TEL: (703)-602-9320  
FAX: (703)-602-5336

Joel Gordon  
USA Concepts Analysis Agency  
8120 Woodmont Avenue  
Bethesda MD 20814  
OFF TEL: (301)-295-1682 DSN: 295-1682  
FAX: (301)-295-1662  
E-mail: Gordon@CAA.Army.mil

DR David R Graham  
Institute for Defense Analyses  
1801 N Beauregard St  
Alexandria VA 22311  
OFF TEL: (703)-845-2358  
FAX: (703)-845-2255

John C Graser  
SAF/FMCC  
1020 Air Force Pentagon  
Pentagon  
Washington DC 20330-1130  
OFF TEL: (703)-697-0734 DSN: 227-0734  
FAX: (703)-694-9873

Marc W Greenberg  
Carderock Division/NSWC  
Code 1210  
Bethesda MD 20084-5000  
OFF TEL: (301)-227-5570 DSN: 287-5570  
FAX: (301)-227-1038

John C Grey  
Naval Surface Warfare Center  
Dalgren Division  
PO Box 990  
Dahlgren VA 22448-0990  
OFF TEL: (703)-663-7369 DSN: 249-7369  
FAX: (703)-663-7898

Gregory G Guernsey  
USAOPTEC  
Attn: CSTE-ZQ  
4501 Ford Avenue  
Alexandria VA 22302-1458  
OFF TEL: (703)-756-2366 DSN: 289-2366  
FAX: (703)-756-0779

Marlon K Guess  
Lockheed Aeronautical Systems Company  
Dept 73-D3, Zone 0685  
86 South Cobb Drive  
Marietta GA 30063-0685  
OFF TEL: (404)-494-9048  
FAX: (404)-494-6355

Camille O Guiar  
The Aerospace Corporation  
SATCOM Architecture Office  
13873 Park Center Road, Suite 187  
Herndon VA 22071  
OFF TEL: (703)-696-1819  
FAX: (703)-696-1963

John J Haas  
BDM International, Inc  
1501 BDM Way  
McLean VA 22102-3204  
OFF TEL: (703)-848-6091  
FAX: (703)-848-6496

Earl W. Hacker  
Whitney, Bradley & Brown, Inc.  
1600 Springhill Rd  
Suite 310  
Vienna VA 22182  
OFF TEL: (703)-448-6081  
FAX: (703)-821-6955

CDR Norma Lee Hackney

James D Hagy  
The MITRE Corporation  
1820 Dolley Madison  
McLean VA 22102  
OFF TEL: (703)-883-6572  
FAX: (703)-883-6817  
E-mail: jhagy@mitre.org

James E Haile  
AFMC Office of Aerospace Studies  
COEA Support Division  
3550 Aberdeen Ave  
Kirtland AFB NM 87117-6008  
OFF TEL: (505)-846-8302 DSN: 246-8302  
FAX: (505)-846-4668

Brian L Haley  
Systems Integration & Research, Inc  
1 Corporate Place  
Newport RI 02840  
OFF TEL: (401)-841-3663  
FAX: (401)-841-3690

John P Harrison

DR Paul Hazell  
Defense Research Agency  
Room 123A, Main Building, DRA Portsdown  
Portsmouth, P064AA, ENGLAND  
OFF TEL: 011 44 705 333 599  
FAX: 011 44 705 333 769

Heide E Heidepriem  
Johns Hopkins University/APL  
Room 13-N422  
Johns Hopkins Road  
Laurel MD 20723-6099  
OFF TEL: (301)-953-5177  
FAX: (301)-953-5910  
E-mail: heide.heidepriem@jhuapl.edu

Mary H. Henry  
HQ TRADOC  
ODCS Training, Training Dev & Anal Dir  
ATTN: ATTG-CR  
Fort Monroe VA 23651-5000  
OFF TEL: (804)-728-5580 DSN: 680-5580  
FAX: (804)-728-5544

William A Hockberger  
Systems Engineering & Economic Analysis  
4102 Beechwood Road  
University Park MD 20782  
OFF TEL: (301)-699-5137  
FAX: (301)-699-5137

Wilbur C Hogan III  
Consultant  
USAMSAA  
Hampton VA 23669  
OFF TEL: (804)-850-8456  
FAX: (804)-850-8640

Mary N Holcomb

DR John G Honig  
Management Analysis, Inc  
Suite 1400  
8200 Greensboro Drive  
McLean VA 22102  
OFF TEL: (703)-506-0505  
FAX: (703)-506-1430

Olympia Hostler  
Tecolote Research Inc  
3601 Aviation Blvd  
Suite 1600  
Manhattan Beach CA 90266  
OFF TEL: (310)-536-0011  
FAX: (310)-536-9922

Kevin J Hoy  
Naval Air Warfare Center  
6000 E 21st Street  
Indianapolis IN 46219-2189  
OFF TEL: (317)-351-4222  
FAX: (317)-351-4662

Linda S Huang  
Tecolote Research, Inc.  
3601 Aviation Blvd  
Suite 1600  
Manhattan Beach CA 90266  
OFF TEL: (310)-536-0011  
FAX: (310)-536-9922

John E Irvine  
AF ASC/XRPC  
Wright-Patterson AFB OH 45433  
OFF TEL: (513)-255-6261 DSN: 785-6261  
FAX: (513)-476-7155

Capt Leslie M Jacobi  
OASN (RD&A)  
Dept of the Navy  
Pentagon, Room 5E715  
Washington DC 20350-1000  
OFF TEL: (703)-614-4290  
FAX: (703)-614-2599

Bill F Jeanes

Douglas R Johnson  
TRAC-WSMR  
Attn: ATRC-WD  
White Sands Missile Range NM 88002  
OFF TEL: (505)-678-3028

Gwendolyn D Jones  
HQ TRADOC  
DCSSA  
ATTN: ATAN-SM  
Fort Monroe VA 23651-5143  
OFF TEL: (804)-728-5808 DSN: 680-5808  
FAX: (804)-727-4394

Peter A Kaczmarek  
Naval Air Warfare Center  
6000 E 21st Street  
Indianapolis IN 46219  
OFF TEL: (317)-351-4010 DSN: 369-4010  
FAX: (317)-351-4662

Carl D Keim  
BDM International, Inc  
1801 Randolph Road, SE  
Albuquerque NM 87106  
OFF TEL: (505)-848-5368 DSN: 246-4682  
FAX: (505)-846-1872

LCDR Douglas M Kelly

Frank Kendall III  
OUSD(A)/TWP  
Pentagon, Room 3E1044  
Washington DC 20301-3000  
OFF TEL: (703)-695-9713  
FAX: (703)-693-7029

DR David LI Kirkpatrick  
Ministry of Defence (UK)  
1, St. Giles High Street  
London WC211 8LD, England  
OFF TEL: (071)-632-6850  
FAX: (071)-632-6909

Kenneth A Klimchuck

David J Koehn

John C Koleny  
NAWC-AD  
MS-3, Bldg 2109  
48108 Stanley Road  
Patuxent River NAS MD 20670-5304  
OFF TEL: (301)-826-7602 DSN: 326-7601  
FAX: (310)-826-7607

LtCol Kenneth C. Konwin  
JAST/PIA  
Suite 307  
1745 Jefferson Davis Hwy  
Arlington VA 22202  
OFF TEL: (703)-602-7390 DSN: 332-7390  
Ext: 6647  
FAX: (703)-602-0646  
E-mail: konwink@ntrprs.jast.mil

Jean C Korkemaz  
SAIC  
1525 Wilson Blvd  
Suite 800  
Arlington VA 22209  
OFF TEL: (703)-528-0508  
FAX: (703)-528-0513

DR Jerry A Kotchka  
McDonnell Douglas Aerospace  
Mail Code 0641251  
PO Box 516  
St. Louis MO 63166-0516  
OFF TEL: (314)-232-2284  
FAX: (314)-232-7917  
E-mail: jkotchka@gwsmt01.mdc.com

John W Kozicki  
Naval Surface Warfare Center  
Dahlgren Division  
Code A50  
Dahlgren VA 22448-5000  
OFF TEL: (703)-663-8307 DSN: 249-8307  
FAX: (703)-663-7440

Glenn F Lamartin  
OUSD(A&T)  
Defensive Systems  
Washington DC 20301  
OFF TEL: (703)-697-5385 DSN: 227-2205  
FAX: (703)-697-2457

Mary A. Lambert  
The MITRE Corporation  
202 Burlington Road  
M/S D-212  
Bedford MA 01730  
OFF TEL: (617)-271-7980  
FAX: (617)-271-7705

Jerry J Lobdill

LTC Andrew G Loerch  
Office Chief of Staff of Army  
Attn: DACS-DPA  
200 Army Pentagon  
Washington DC 20310-0200  
OFF TEL: (703)-695-7737 DSN: 225-7737  
FAX: (703)-693-6993  
E-mail: loerch@pentagon-hqdadss.army.mil

Joan S Lovelace  
The MITRE Corporation  
1820 Dolley Madison Blvd  
McLean VA 22102-3481  
OFF TEL: (703)-883-6154

Charles S Lubin  
Naval Surface Warfare Center  
Carderock Division, Code 212  
Bethesda MD 20084  
OFF TEL: (301)-227-5239 DSN: 287-5239  
FAX: (301)-227-1038

Adam J Macksoud  
Naval Undersea Warfare Center  
Code 8292  
Bldg 161  
Newport RI 02841-5047  
OFF TEL: (401)-841-3663 DSN: 948-3663  
FAX: (401)-841-3690

LCDR Richard O Madson Jr  
COMOPTEVFOR  
Attn: Code 332H  
7970 Diven St  
Norfolk VA 23505-1498  
OFF TEL: (804)-444-2954 DSN: 564-2954  
FAX: (804)-445-8516

Jeffrey A Manickas  
Naval Undersea Warfare Center  
Division Newport  
Newport RI 02841-5047  
OFF TEL: (401)-841-4299 DSN: 948-4299  
FAX: (401)-841-1315  
E-mail: manickas@nusc.npt.navy.mil

Frederick J Manzer  
DSMC  
Fort Belvoir VA 22060-5426  
OFF TEL: (703)-805-2451 DSN: 655-2451  
FAX: (703)-805-3184

James F Manzo

Joseph J Manzo  
The MITRE Corporation  
JCOS Dept W159  
1820 Dolley Madison Blvd  
McLean VA 22102-3481  
OFF TEL: (703)-446-4592  
FAX: (703)-883-1379  
E-mail: manzoj@mitre.org

Kenneth E Marks  
Aerojet  
(119/1344)  
1100 W. Hollyvale  
Azusa CA 91702  
OFF TEL: (818)-812-1314  
FAX: (818)-812-1807

Angel Matta  
NAWCADLKE  
Code SR44  
Lakehurst NJ 08733  
OFF TEL: (908)-323-1494

MAJ Verna J McBride  
AF/PEY  
Pentagon, Room 1D377  
Washington DC 20330  
OFF TEL: (703)-697-9329 DSN: 227-9329  
FAX: (703)-697-3441

Leander McClain  
Naval Air Warfare Center  
Training Division  
Code AD0573  
Lakehurst NJ 08733-5059  
OFF TEL: (908)-323-2915

Daniel A McInnis  
ASC/XRYS  
Eglin AFB FL 32542  
OFF TEL: (904)-882-4455 DSN: 872-4455  
FAX: (904)-882-9049

James C McManus  
Armstrong Laboratory  
OL-AL/HRGA  
2698 G Street  
Wright-Patterson AFB OH 45433-7601  
OFF TEL: (513)-255-8049 DSN: 785-8049  
FAX: (513)-255-6555

DR Gerald R McNichols  
Management Consulting & Research, Inc  
Suite 300  
1505 Farm Credit Drive  
McLean VA 22102  
OFF TEL: (703)-506-4600  
FAX: (703)-918-9333  
E-mail: 3480043@mcimail.com

DR David L McNicol  
OSD (PA&E)  
Pentagon, Room 2E314  
Washington DC 20301

John Melin  
NAWCADLKE  
Code SR44  
Lakehurst NJ 08733  
OFF TEL: (908)-323-1494 DSN: 624-1494

Patricia E Mickley  
HQ US Space Command  
FMAM  
150 Vandenburg Street, 1105  
Peterson AFB CO 80914-4010  
OFF TEL: (719)-554-3698 DSN: 692-3698  
FAX: (719)-554-3698

Donald E Mixon

David C Moershel  
USCC Naval Engineering  
2100 2nd St, SW  
Washington DC 20593  
OFF TEL: (202)-267-2002

Steven P Moore  
NARSEA 017  
2531 National Center  
Building 3  
Washington DC 20362-5077  
OFF TEL: (703)-602-2023 DSN: 332-5077  
FAX: (703)-602-0522

Richard P Munro  
SAIC  
POB 46565  
Washington DC 20050-6565  
OFF TEL: (703)-697-4102  
FAX: (703)-695-2747

Kevin M Murray

CDR Stephen E Myers  
Naval Postgraduate School  
Code OR/My  
Monterey CA 93943  
OFF TEL: (408)-646-2569 DSN: 878-2569

John K Narney  
PRC, Inc  
2750 Killarney Dr  
Suite 200  
Woodbridge VA 22192  
OFF TEL: (703)-730-1951  
FAX: (703)-730-1960

Edward G Nedimala  
Federal Aviation Administration  
800 Independence Ave, SW  
Washington DC 20591  
OFF TEL: (202)-287-8515  
FAX: (202)-287-8531

Peter E Neperyd  
John Hopkins University/APL  
John Hopkins Road  
Laurel MD 20723-6099  
OFF TEL: (301)-953-6894  
FAX: (301)-953-6896

Grant G Nicolai  
Vought Aircraft Company  
Suite 900  
1725 Jefferson Davis Hwy  
Arlington VA 22202  
OFF TEL: (703)-412-4924  
FAX: (703)-412-4977

DR Daniel A Nussbaum  
Naval Center For Cost Analysis  
1111 Jeff Davis Hwy  
Suite 400 West  
Arlington VA 22202-4306  
OFF TEL: (703)-604-0293 DSN: 664-0293  
FAX: (703)-604-0315  
E-mail: nussbaum-dan@hq.secnv.navy.mil

Jeffrey D O'Connell  
Battelle Memorial Institute  
Suite 600  
1725 Jefferson Davis Hwy  
Arlington VA 22202  
OFF TEL: (703)-413-8866  
FAX: (703)-413-8880

James H O'Rourke  
US Army Total Cost & Econ Analysis Ctr  
5611 Columbia Pike  
Falls Church VA 22041-5050  
OFF TEL: (703)-756-0330 DSN: 289-0330  
FAX: (703)-756-2601

Paul Oranski  
Tecalote Research Inc  
3601 Aviation Blvd  
Suite 1600  
Manhattan Beach CA 90266  
OFF TEL: (310)-536-0011

Joseph F Orlando

DR Ivar Oswalt  
Kapos Associates  
Suite 1900  
1101 Wilson Blvd  
Arlington VA 22209-2248  
OFF TEL: (703)-528-4575  
FAX: (703)-276-1264

Jerome E Pannullo  
OSD PA&E  
Econ Analysis & Resource Planning Div  
Pentagon, Room 2D311  
Washington DC 20301-1800  
OFF TEL: (703)-697-2999 DSN: 227-2999  
FAX: (703)-693-5707

DR Richard R Pariseau  
Advanced Marine Enterprises  
Suite 1300  
1725 Jefferson Davis Hwy  
Arlington VA 22202  
OFF TEL: (703)-413-9200  
FAX: (703)-413-9221

Janet L Peasant  
Air Force Armstrong Laboratory  
OL AL HSC/HRGA, Bldg 190  
2698 G. Street  
Wright-Patterson AFB OH 45433-7604  
OFF TEL: (513)-255-8502 DSN: 785-8502  
FAX: (513)-255-6555  
E-mail: jpeasant@alhrp.wpafb.af.mil

LtCol John G Pennett

LtCol Ronald V Phillips

Albert A Pisani  
TASC  
1101 Wilson Blvd  
Suite 1500  
Arlington VA 22209  
OFF TEL: (703)-358-9090  
Ext: 6576  
FAX: (703)-524-6666  
E-mail: aapisani@tasc.com

Daniel J Platt  
Naval Surface Warfare Center  
Carderock Division/Code 21  
Bethesda MD 20084-5000  
OFF TEL: (301)-227-3112 DSN: 287-3112  
FAX: (301)-227-1038

Joseph Polito  
Sandia National Laboratories  
Department 9911  
MS 0163  
Albuquerque NM 87185  
OFF TEL: (505)-844-6217  
FAX: (505)-844-0884  
E-mail: jpolito@sandia.gov

DR Francis M. Ponti  
DoD Inspector General  
400 Army Navy Drive  
APTS, Room 801  
Arlington VA 22202-2884  
OFF TEL: (703)-614-9159 DSN: 224-9156  
FAX: (703)-614-8542

Maria R Ponti  
Naval Air Systems Command  
1421 Jefferson Davis Highway  
Washington DC 20361  
OFF TEL: (703)-692-9182  
FAX: (703)-692-9600

Michael E Popp

Daniel L Porter

DR Herbert C Puscheck

CDR Gregory A Queen  
Office of the CNO  
N421C  
2000 Navy Pentagon  
Washington DC 20350-2000

Maria K Rachko  
Space and Naval Warfare Systems Com  
Code 312-4  
Washington DC 20363-5200  
OFF TEL: (703)-602-4541 DSN: 332-4541  
FAX: (703)-602-5891  
E-mail: mkrachko@smtp-gw.spawar.navy.mil

Thomas G Ready  
Naval Surface Warfare Center  
Carderock Division  
Bethesda MD 20084-5000  
OFF TEL: (301)-227-5282  
FAX: (703)-227-1038

Ted E Ribultan  
US Naval Warfare Center  
Cost Analysis Division, Code CO245  
China Lake CA 93555  
OFF TEL: (619)-939-8614 DSN: 437-8614  
FAX: (619)-939-2232

Lance M. Roark  
OSD (PA&E)  
The Pentagon, Room 2E314  
Washington DC 20301-0180  
OFF TEL: (703)-695-9848 DSN: 225-9848  
FAX: (703)-693-5707

John David R Robertson  
White Oak Detachment  
10901 New Hampshire Ave  
Silver Spring MD 20903-5001  
OFF TEL: (301)-394-2930 DSN: 290-2930  
FAX: (301)-394-3610

Larry D Robertson  
US Army Cost & Econ Analysis Ctr  
Attn: SFFM-CA-CC  
5611 Columbia Pike  
Falls Church VA 22041-5050  
OFF TEL: (703)-756-2049 DSN: 289-2049  
FAX: (703)-756-7553

Allen D Roe  
Veda, Inc  
5200 Springfield Pike, #200  
Dayton OH 45431-1255  
OFF TEL: (513)-476-3513  
FAX: (513)-476-3577

PROF Bernard H. Rudwick  
Defense Systems Management College  
Code FD-FM  
Fort Belvoir VA 22060  
OFF TEL: (703)-805-2451 DSN: 655-2451  
FAX: (703)-805-3184

William A Rumbaugh  
DISA  
D81  
3701 N. Fairfax Drive  
Arlington VA 22203-1713  
OFF TEL: (703)-696-1819 DSN: 226-1819  
FAX: (703)-696-1963  
E-mail: rumbaughw@ncr.disa.mil

Frederick Sander  
NAWCADLKE  
Code SR4  
Lakehurst NJ 08733  
OFF TEL: (908)-323-1494

Carson W Sasser  
AFMC/ASC/XREW  
101 W. Eglin Blvd  
Ste 384  
Eglin AFB FL 32542-5499  
OFF TEL: (904)-882-4151 DSN: 872-4151  
FAX: (904)-882-8125  
E-mail: sasser@eglin.af.mil



Marvin B Schaffer  
RAND  
1700 Main Street  
P.O. Box 2138  
Santa Monica CA 90407-2138  
OFF TEL: (310)-393-0411  
Ext: 7298  
FAX: (310)-393-4818  
E-mail: Marv\_Schaffer@rand.org

David D Schuller  
Naval Undersea Warfare Center  
NUWC Division, Newport  
Code 22341  
Newport RI 02841-5047  
OFF TEL: (401)-841-4227 DSN: 948-4227  
FAX: (401)-948-2130

LCDR Carl W Schumaker  
AMC  
PO Box 33803  
Wright-Patterson AFB OH 45433-0803  
OFF TEL: (513)-255-7777 DSN: 785-7777

Robert B Schwenke  
ASC/FMCE  
1970 Third St - Bldg 11A  
Suite 6  
Wright-Patterson AFB OH 45433-7213  
OFF TEL: (513)-255-6347 DSN: 785-6347  
FAX: (513)-255-8378

George J Seidl  
MARCORSYSCOM  
Suite 315  
2033 Barnett Avenue  
Quantico VA 22134  
OFF TEL: (703)-640-2420 DSN: 278-2420  
FAX: (703)-640-2168

CDR Alfred R Seifert

Jere W Sharp  
General Research Corporation  
1900 Gallows Road  
Vienna VA 22182  
OFF TEL: (703)-506-5513  
FAX: (703)-506-9241

Carl Shrake  
Global Associates Ltd  
7600 Leesburg Pike  
Falls Church VA 22043-2004  
OFF TEL: (703)-351-5660  
FAX: (703)-351-5651

Arve R Sjovald  
Tecolote Research, Inc  
Rm 301  
5266 Holister Ave  
Santa Barbara CA 93111  
OFF TEL: (805)-964-6963  
FAX: (805)-964-7329

Cynthia A Slaughter  
HQ AETC/FMAF  
550 C Street West  
Suite 49  
Randolph AFB TX 78150-4751  
OFF TEL: (210)-652-6322 DSN: 487-6322  
FAX: (210)-487-2938

Ann S Smith  
HQ AMC  
Attn: AMCRM-CE  
5001 Eisenhower Ave  
Alexandria VA 22333-0001  
OFF TEL: (703)-274-9101 DSN: 284-9101  
FAX: (703)-274-8425

MAJ Kevin C Smith  
USAF/XOM  
1480 Air Force, Pentagon  
Washington DC 20330-1480  
OFF TEL: (703)-695-1833 DSN: 225-1833  
FAX: (703)-693-1161  
E-mail: ksmith@xom-mail.hq.af.mil

V. Ruth Smith  
AETC SAF/CS  
151 J Street E  
Suite 2, Bldg 990  
Randolph AFB TX 78150-4343  
OFF TEL: (210)-652-4201 DSN: 487-4121  
FAX: (210)-652-6895  
E-mail: smithr@aetc\_saf.af.mil

Donna M Snead  
SAIC-ATG  
1525 Wilson Blvd  
Arlington VA 22209-2411

Evan Soffer  
Federal Aviation Administration  
AOR-100  
800 Independence Ave, SW3  
Washington DC 20591  
OFF TEL: (202)-287-8507  
FAX: (202)-287-8531

Frank C Sonsini  
DoD IG/AUDIT/APTS  
400 Army Navy Drive  
Room 801  
Arlington VA 22202-2884  
OFF TEL: (703)-604-8925 DSN: 664-8925  
FAX: (703)-604-8932  
E-mail: fsonsini@dodig.osd.mil

Robert Soule  
Office of Secretary of Defense  
Director, Program Analysis & Evaluation  
The Pentagon, Room 1E836  
Washington DC 20301  
OFF TEL: (703)-695-0971

PROF Michael G Sovereign  
Naval Postgraduate School  
Dept of OR  
Monterey CA 93943-5000  
OFF TEL: (408)-656-2428 DSN: 878-2428  
FAX: (408)-656-2595  
E-mail: MSOVEREIGN@NPS.NAVY.MIL

LTC Myron A Spears Jr

John M Spiritosanto  
RAND  
PO Box 7003  
Rockford IL 61125-7003  
OFF TEL: (815)-394-5920  
FAX: (815)-266-2699

Greg A Staley

Siegfried R Stief

George L Stratton

Pamela G Struzyk  
HQ ATC (AETC)/FMATE  
555 E Street East  
Suite 4  
Randolph AFB TX 78150-4459  
OFF TEL: (210)-652-6321 DSN: 487-6321

James S Sunderlin  
TASC  
Suite 1500  
1101 Wilson Blvd  
Arlington VA 22209  
OFF TEL: (703)-351-6343  
FAX: (703)-524-6666

Ellis D Sutter  
Global Associates Ltd.  
Suite 205  
2300 Clarendon Blvd  
Arlington VA 22201  
OFF TEL: (703)-351-5660  
FAX: (703)-351-5651

Robert M Talis

MAJ Stanley C Tatum  
HQ AFMC/FMCW  
645 MSSQ/MSUO  
Wright-Patterson AFB OH 45433  
OFF TEL: (513)-257-3920 DSN: 787-3920

Dianne D Taylor  
HQ ACC/XP-JSG  
Langley AFB VA 23665

Clayton J Thomas FS  
HQ USAF/SAN  
1570 Air Force Pentagon  
Room 1E387  
Washington DC 20330-1570  
OFF TEL: (703)-697-4300 DSN: 227-4300  
FAX: (703)-697-3441  
E-mail: thomasc@afsa.hq.af.mil

MAJ Mark E Tillman  
US Military Academy  
Dept of Systems Engineering  
West Point NY 10996  
OFF TEL: (914)-938-5672 DSN: 688-5672  
FAX: (914)-688-5665  
E-mail: fm0648@usma8.usma.edu

Kenneth D Tourison  
Battelle Memorial Institute  
Suite 600  
1725 Jefferson Davis Hwy  
Arlington VA 22202-4172  
OFF TEL: (703)-413-8866  
FAX: (703)-413-8880

William T Towles  
Naval Surface Warfare Center  
Code A50  
Dahlgren VA 22448-5000  
OFF TEL: (703)-663-8110 DSN: 249-8110  
FAX: (703)-663-7898  
E-mail: wtowles@nswc.navy.mil

DR Richard J Trainor

John C Trumbule  
Naval Surface Warfare Center  
Carderock Div  
Code 1210  
Bethesda MD 20084-5000  
OFF TEL: (301)-227-5570 DSN: 287-5570  
FAX: (301)-227-1038

Brian P Ullrich

1LT Eric J Unger  
ESC/TGN  
11 Eglin Street  
Hanscom AFB MA 01731-2120  
OFF TEL: (617)-377-8902 DSN: 478-8928  
FAX: (617)-377-7447

Janet M Vacca-Leboeuf

William W Vardeman

Leroy Verbillion

DR James L Vernon  
BETAC Corporation  
2001 N. Beauregard Street  
Alexandria VA 22311  
OFF TEL: (703)-824-3223  
FAX: (703)-824-0333

Eugene P Visco FS  
SAUS-OR  
102 Army Pentagon  
Room 1E643  
Washington DC 20310-0102  
OFF TEL: (703)-697-1175 DSN: 227-1175  
FAX: (703)-697-7748  
E-mail: visco@pentagon-hqdadss.army.mil

Debbie Vogel  
SCEA  
101 S. Whiting Street Suite 201  
Alexandria VA 22304

John F VonLoh  
SAIC  
2301 Yale Blvd, SE  
Suite E  
Albuquerque NM 87106  
OFF TEL: (505)-766-7433  
FAX: (505)-766-7498

Robert L Walker  
HQ AMC  
Attn: AMCRM-CE  
5001 Eisenhower Ave  
Alexandria VA 22333-0001  
OFF TEL: (703)-274-9212 DSN: 284-9212  
FAX: (703)-274-8425

MAJ Sylvia C. Wardley-Niemi  
AFCAA/OSF  
The Pentagon, Room 4D167  
Washington DC 20330-1000  
OFF TEL: (703)-695-3621 DSN: 225-3621  
FAX: (703)-614-9873

Capt Keith R Weyenberg  
ASC/VJM  
Wright-Patterson AFB OH 45433  
OFF TEL: (513)-255-1514 DSN: 785-1514

DR James M Whitehead  
BDM International  
1501 BDM Way  
McLean VA 22102-3204  
OFF TEL: (703)-848-6264  
FAX: (703)-848-6331

Richard I Wiles  
Military Operations Research Society  
101 S Whiting Street  
Suite 202  
Alexandria VA 22304  
OFF TEL: (703)-751-7290  
FAX: (703)-751-8171  
E-mail: rwiles@dtic.dla.mil

Linda S Wilkins  
ANSER  
Suite 800  
1215 Jefferson Davis Hwy  
Arlington VA 22202  
OFF TEL: (703)-685-3273  
FAX: (703)-685-3225

Lynne M Willis  
ASC/XREWM  
101 W. D Ave, Suite 384  
Eglin AFB FL 32542-5499  
OFF TEL: (904)-882-9417 DSN: 872-9417  
FAX: (904)-882-9049  
E-mail: willisly@tam.eglin.af.mil

Arthur C Winn

David R Wollover

COL Buddy B Wood  
HQ USAF/SS  
Room 4C1000  
Washington DC 20330  
OFF TEL: (703)-694-0408  
FAX: (703)-323-7943  
E-mail: bbwood@aol.com

Debra C Woodard  
OD(PA&E)IMAG  
Crystal Gateway II, Suite 300  
1225 Jefferson Davis Hwy  
Arlington VA 22202-4301  
OFF TEL: (703)-604-6349 DSN: 664-6349  
FAX: (703)-604-6400  
E-mail: woodardc@mailhost.pae.osd.mil

Cooper L Wright  
Vanguard Research Inc  
10306 Eaton Place  
Suite 450  
Fairfax VA 22030  
OFF TEL: (703)-934-6300  
FAX: (703)-273-9398

Alice W Yee  
US Army Total Cost & Econ Analysis Ctr  
5611 Columbia Pike  
Falls Church VA 22041-5050  
OFF TEL: (703)-756-2018 DSN: 289-2018  
FAX: (703)-756-7553

James L York  
SAIC  
1710 Goodridge Drive  
MS T-1-7-2  
McLean VA 22102  
OFF TEL: (703)-734-4015  
FAX: (703)-821-1037

Robert W Young  
US Army Total Cost & Econ Analysis Ctr  
5611 Columbia Pike  
Falls Church VA 22041-5050

Paul Zatz  
Naval Undersea Warfare Center  
NUWC Division, Newport  
Code 8292, Bldg 161  
Newport RI 02841-5047  
OFF TEL: (401)-841-3663 DSN: 948-3663  
FAX: (401)-841-3609

Francis H Zeleznik  
PEO for Armaments  
Business Mgmt Bldg 171  
Picatinny Arsenal NJ 07861-5000  
OFF TEL: (201)-724-7106 DSN: 880-7106  
FAX: (201)-724-7127